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ABSTRACT

In response to low completion rates in a calculus course for a biology, management, and social sciences program at California's Orange Coast College (OCC), a project was undertaken to develop a revised course outline for the college's pre-calculus course to better prepare students for success in calculus. Specifically, the project sought to determine appropriate topics for the outline and the most effective sequence of topics. To gather information for the new outline, a literature review was undertaken and outlines from pre-calculus courses at five local community colleges were analyzed. Once the new outline was developed, a summative review was performed to determine appropriateness. The results suggested that the revised outline needed to include the following sequence of topics: a review of intermediate algebra, rational functions, systems of equations, binomial theorem, sequences and series, logarithmic/exponential functions, and probability, with matrices included as an optional topic. It was recommended that OCC's Mathematics Department adopt the revised course outline, evaluate it shortly after implementation, and track the success rate in calculus of students who complete the pre-calculus course under the outline. Contains 35 references. Appendixes provide descriptions of faculty members involved in the formation and evaluation of the new outline, criteria used, and the revised outline. (HAA)

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# DEVELOPMENT OF A REVISED COURSE OUTLINE IN PRECALCULUS FOR BIOLOGICAL, MANAGEMENT, AND SOCIAL SCIENCES AT ORANGE COAST COLLEGE

Curriculum and Program Planning

E. J. Arismendi-Pardi

Orange Coast College

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A practicum report presented to Programs for Higher Education in partial fulfillment of the requirements for the degree of Doctor of Education

Nova Southeastern University

July, 1996

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by

E. J. Arismendi-Pardi

July, 1996

The problem under investigation was that of the students who successfully completed a precalculus course for biological, management, and social sciences (BMSS), only 52% successfully completed the required 1-semester calculus for BMSS at Orange Coast College (OCC). The purpose of this study was to develop a revised course outline in precalculus to better prepare students for success in calculus. There were two research questions for this study. First, "What are the appropriate topics for a course outline in precalculus for BMSS students at OCC?" Second, "What should be the specific sequence of topics in the course outline?"

The procedures used to develop the product included: A review of literature, establishment and validation of formative criteria, review of current course outlines in precalculus from five nearby community colleges in Orange County, development of a revised course outline, and a summative review of the revised course outline.

The results suggested that the revised course outline needed to include the following content and sequence of topics: review of intermediate algebra, rational functions, systems of equations, binomial theorem, sequences and series, logarithmic/exponential functions, probability, and matrices as an optional topic. It was concluded that the revised course outline will better prepare students for success in calculus. It was recommended that the Mathematics Department adopt the revised course outline, evaluate it shortly after its implementation, and track the success rate in calculus of students who complete the precalculus course under the revised course outline.

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# Chapter 1

## INTRODUCTION

Orange Coast College is a public 2-year institution offering the Associate in Arts (A.A.) degree, certificates of completion, vocational education programs, community services, and college transfer programs for students whose majors require four or more years of college education. Orange Coast College (OCC) is one of three colleges in the Coast Community College District and was founded in 1947. The college is known as Southern California's leading transfer institution (Orange Coast College, 1995).

### Nature of the Problem

One major component of baccalaureate degree programs in biology, management, and social sciences (BMSS) is the completion of a calculus course. A precalculus course for BMSS majors is designed to prepare students for a 1-semester course in calculus. Through the precalculus course, advanced algebraic and problem solving skills are sharpened in preparation for the 1-semester calculus course, which is required for graduation. The problem is that of the students successfully completing the precalculus course, only 52% successfully complete the required 1-semester calculus course (S. Johnson, personal communication, February 27, 1995). Furthermore, K. L. Shannon (personal communication, March 7, 1995) discusses the lack of adequate preparation in precalculus mathematics in its role as a prerequisite for the calculus course. In his opinion, the current course outline for precalculus does not cover all of the appropriate precalculus topics such as introduction to limits and curve sketching

techniques of rational functions. He believes that the course outline should be revised to include topics that would more adequately prepare students for the 1-semester calculus course for BMSS majors. One way to address the problem was to develop a revised course outline in precalculus for BMSS students that addresses the topics necessary for the successful completion of calculus for BMSS majors.

## Purpose of the Study

The purpose of this study was to develop a revised course outline in precalculus to better prepare students for success in the calculus course for BMSS majors.

## Significance to the Institution

Many Orange Coast College BMSS students, while successfully completing course requirements to transfer to a 4-year institution, fail to complete the 1-semester calculus course. It is anticipated that the revised course outline in precalculus for BMSS students in its role as a prerequisite for calculus will improve the completion rate in calculus for BMSS students. It is also anticipated that the college will be better able to use its resources in assisting students to transfer to 4-year institutions.

## Relationship to Seminar

This practicum was directly related to the Curriculum and Program Planning seminar in that principles of curriculum design were used in the development of a revised course outline. Ornstein and Hunkins (1993) assert that the design of curriculum requires careful planning of sequence content and prerequisites

for learning (p. 239). The completion of this practicum required in-depth study of curriculum development theory in mathematics education as well as understanding of the desired outcomes of the revised course outline.

## Relationship to Concentration

The author's area of concentration is mathematics education. The development of a revised course outline in precalculus for BMSS is an essential component of mathematics education. There is an interrelationship between the nature of this practicum and the selected area of concentration.

## Research Questions

There were two research questions for this study. First, "What are the appropriate topics for a course outline in precalculus for BMSS students at OCC?". Second, "What should be the specific sequence of topics in the course outline?".

## Definition of Terms

For the purposes of this practicum, the following terms needed clarification.

Binomial Theorem. A rule for the expansion of a power of an expression consisting of two terms connected by a plus or minus sign.

BMSS. A calculus or precalculus mathematics course with applications in biological, management, and social sciences.

Calculus. A mathematics course of study that deals with change and motion.

Calculus for BMSS. A mathematics course of study that deals with change and motion as it relates to the biological, management, and social sciences.

College Algebra. A mathematics course of study covering a wide range of topics in advanced algebra that are prerequisite for the study of business calculus.

Combination. An arrangement of objects where the order of each object is considered unimportant.

Conics. A figure that is formed by the intersection of a plane with a cone.

Exponential function. Any function in which the variable, or variables, occur as powers.

FC. Fullerton College is a public 2-year institution in Orange County offering similar programs to Orange Coast College.

Function. The one-to-one relation that exists between numbers and points in a given two-dimensional coordinate plane.

Geometric Progression. A series in which each term is formed by multiplying the previous term by the same quantity, called the common ratio.

GWC. Golden West College is a public 2-year institution in Orange County offering similar programs to Orange Coast College.

Inequality. An algebraic expression that has any of the following symbols: $<$, $>$, $\geq$, or $\leq$.

IVC. Irvine Valley College is a public 2-year institution in Orange County offering similar programs to Orange Coast College.

Logarithm. The power to which it is necessary to raise a given number, called the base, to produce the number.

Mathematical Induction. A theorem which is thought to be true for all values of "n", which is proved to be true by showing that if n=1 is true, then it is also true for n=1,2,3, etc. Hence, generalizing that if n=r is true, then it is also true for n=r+1.

OCC. Orange Coast College is a public 2-year institution offering the Associate in Arts (A.A.) degree, certificates of completion, vocational education programs, community services, and college transfer programs for students whose majors require four or more years of college education.

Permutation. An ordered arrangement of objects.

Precalculus. A mathematics course of study that encompasses topics in advanced algebra, trigonometry, and elementary functions which are prerequisites for the study of calculus.

Precalculus for BMSS. A mathematics course of study that encompasses the study of advanced algebra that is a prerequisite for the study of calculus for BMSS. Precalculus is referred to as college algebra at many other colleges.

Probability Theory. A branch of mathematics, a course of study, or a topic within a course of study that deals with the analysis of the likelihood of the occurrence of an event.

Radical Expression. Any function or relation in which the variable, or variables occur as fractional powers.

Rational Expression. Any function or relation which does not involve an irreducible radical.

Rational Function. The ratio of two polynomials of the form P(X)/Q(X) with Q(X) not equaling to zero.

RSC. Rancho Santiago College is a public 2-year institution in Orange Ccunty offering similar programs to Orange Coast College.

SC. Saddleback College is a public 2-year institution in Orange County offering similar programs to Orange Coast College.

Sequence. A set of numbers or terms which follow each other in a definite order in such a way that each number can be calculated from a knowledge of its position in the sequence, or from a knowledge of the previous term.

Series. A sequence of terms connected by either a plus or minus sign, or a combination of both.

Sigma Notation. A mathematical symbol that is used to denote finite or infinite sums.

System of Equations. A group of two or more equations.

Word Problems. A mathematical exercise that expositorily presents a situation that can be analyzed and solved by applying certain mathematical rules or axioms.

# Chapter 2

## REVIEW OF THE LITERATURE

A review of the literature of design and development of courses in general and mathematics courses in particular provided a theoretical foundation for this problem solving practicum. This chapter presents (a) design, development, and content of a general course outline, (b) design and development of a mathematics course outline, (c) design and development of a precalculus course outline, and (d) the sequence and content of a precalculus course outline.

### Design, Development, and Content of a General Course Outline

A literature investigation of design and development for a general course outline revealed an abundance of studies suggesting a variety of approaches to create effective course outlines. There appears to be a consistency in the suggestions made by experts in designing and developing general course outlines.

According to Altman and Cashin (1992), the primary purpose of a course outline is to communicate to students what the course is about, why the course is taught, and what will be required of the students for them to complete the course with a passing grade (p. 1). A study conducted by Gallagher (1991) indicated that there was "a great difference between what is being taught and what course titles describe" (p. 83). Hence, a course outline needs to emphasize the topics that are most needed by the majority of students (Carlson, Johnson, Lay, & Porter, 1993, p. 41).

Regarding the objectives that a course outline should have, Gallagher (1991) concludes that there are two general objectives: (a) to prepare students to be consumers of the subject matter information, and (b) to motivate a few students to take further courses to become subject matter experts (p. 82). In creating a course outline, Dean (1991) suggests "considering all sequel courses for which the given course is a prerequisite when agreeing on standards" (p. 4). His research indicates that students who successfully complete a prerequisite course with high standards have a 0.83 probability of successfully completing the succeeding course (Dean, 1991, p. 7).

Several authors indicate the need for the course outline to contain a logical sequence of major topic headings that relate to the goals and objectives of the course (McKeachie, 1994, pp. 16-17; Kemp, Morrison, & Ross, 1994, pp. 8-9). The design and development of a logical course outline must address the following questions: "What should we teach?, why should we teach one thing rather than another?, and who should have access to what knowledge?" (Stanic, 1989, p. 66). The course outline needs to present the headings of topics in such a way that easier concepts or ideas are preceded by abstract concepts or ideas (Nibbelink, 1990, p. 49).

Finally, Altman and Cashin (1992) suggest that the design elements for the development of an effective course outline contain information such as major content areas, course information, course title, course number, credit hours, prerequisites if applicable, recommended texts, description of

the goals and objectives of the course, and grading policies (pp. 1-2). Roberts (1993) concurs with many suggestions provided by Altman and Cashin (1992). She identifies the main elements for a course outline to be course title, required texts, prerequisite courses if applicable, course description, course objectives, course content information in the form of main topical headings, and course evaluation (Roberts, 1993, p. 3).

Design and Development of a Mathematics Course Outline

In designing a mathematics course outline, one must anticipate the intended learning process of the students in order to bridge the disparity that exists between mathematical theory and realistic application (Streefland, 1993, p. 132). Hence, the design for a mathematics course outline should, according to Boyce (1994), provide three experiences: "conceptualization, exploration, and higher level problem solving" (p. 364). According to Garofalo and Durant (1991), conceptual understanding is necessary to make mathematics truly useful (p. 54). Boyce (1994) also states that emphasis on conceptual understanding is crucial in problem solving, because conceptualization becomes part of a student's mindset (p. 364). In other words, the primary goal in designing a mathematics course outline is to have students formulate basic equations and to analyze and interpret the solutions to these basic equations (Blanchard, 1994, p. 387). It is, therefore, important for the syllabus or outline to contain challenging word problems to emphasize creativity and provide motivating applications (Carlson, Johnson, Lay & Porter, 1993, p. 42; Douglas, 1988, p. B1; Evans, 1991, p. 13).

Wilson (1991) reports that a mathematics course outline for a particular course requiring a prerequisite should contain the equivalent of a 2-week review of the prerequisite material to close the chasm that might exist between the preceding and succeeding courses (pp. 56-57). According to Rotman (1991), skills in a prerequisite course are needed before a student can master a subsequent course (p. 3).

Research conducted by Johnson (1989), reveals that the course outline for a mathematics course designed for BMSS students should stress applications and techniques for solving problems in business and social science (pp. 5 & 8). He also states that the "mathematical expectations are rising for students in business and social science" (Johnson, 1989, p. 9).

The course outline needs to reflect fewer topics to thus create more time for increasing the probability to master prerequisite material (Westbury, 1992, pp. 22 & 23). This view is supported by Kysh (1991) who concludes that the curriculum needs to de-emphasize the simplification of rational expressions and radicals to thus increase more time on problem solving and graphing techniques (pp. 716-717). In addition, Douglas (1988) states that "many mathematicians agree that the syllabus [course outline] should contain fewer topics, and that the course should have more conceptual depth, both numerical and geometrical" (p. B1).

In redesigning or revising a mathematics course outline, at most ten percent of the topics should require the use of technology (Cornéz, Beery, & Scherer, 1993, p. 47). The use of

technology such as "calculators do not play a central role in problem solving, but they can help facilitate the process. . . Applications can be more realistic . . . [and] attention can be focused on comprehension of the problem rather than on . . . arithmetic" (Darken, 1991, p. 10). It is important to note that the mathematical community is divided over the issue concerning the use of technology in the curriculum (Darken, 1991, p. 10). Other researchers recommend the integration and use of technology where appropriate and only as a tool to enhance mathematical theory (Ferrini-Mundy & Geuther-Graham, 1991, p. 632; Spresser, 1986, p. 30).

Finally, in the design process for the development of a course outline, the purpose of instruction must address four fundamental elements: Learners, objectives, methods, and evaluation (Kemp, Morrison, & Ross, 1994, p. 8). Regarding these four fundamental elements, Kemp, Morrison and Ross (1994) indicate that the elements must be interrelated and work synergetically to thus optimize the instructional design process (p. 8).

Design and Development of a Precalculus Course Outline

According to Toom (1993), the design and development of an effective precalculus course outline as a prerequisite to business calculus depends on strong algebraic skills such as exponential functions and geometric progressions (pp. 12-13). Nichols (1988) concurs with Toom (1993) in that her research has indicated that algebraic skills are the foundation for further study in mathematics (p. 236). Furthermore, Garofalo and Durant

(1991) state that "knowledge of applied functions and graphs are important prerequisites . . . in 'typical' precalculus mathematics courses" (p. 52). Hence, the purpose of a college algebra [precalculus] course outline is to prepare students for the study of calculus (Haver & Turbeville, 1991, p. 227). Furthermore, research in mathematics education conducted by Bridgeman and Wendler (1995) suggests that performance patterns in algebra are correlated to performance patterns in calculus (p. 277). Many educational researchers concur with Bridgeman and Wendler (1995) in that studies indicate that an effective course outline for a calculus prerequisite course needs to emphasize the importance of algebraic and problem solving skills (Cohen, 1995, pp. 10-13; Edge & Friedberg, 1984, p. 137; O'Brien & Chalif, 1991, p. 6; Westbury, 1992, p. 20).

Roitberg (1987) states that the objectives of a precalculus course outline are:

1.) To provide the necessary mathematical foundation for success in calculus.
2.) To develop the students' ability to think logically by presenting sound mathematical arguments.
3.) To enhance the students' analytic skills through problem solving. (p. 2)

Sequence and Content of a Precalculus Course Outline

Roberts (1993) suggests nine content areas for a course in precalculus mathematics: "Algebra fundamentals, equations and inequalities in one-variable, graphs and functions, working with functions, polynomial equations, exponential and logarithmic functions, conics, systems of equations and inequalities, and additional topics from algebra" (p. 3). These additional topics

from algebra include sigma notation, mathematical induction, binomial theorem, sequences and series, permutations and combinations, and probability theory (Roberts, 1993, pp. 47-48).

The content for a college algebra or precalculus course must emphasize real-world situations, translating a situation to an abstract mathematical problem, solving the abstract problem, and applying what is learned to the original situation (Haver & Turbeville, 1995, p. 46). Furthermore, the mathematical course content according to Odafe (1994) "should reflect the present and future uses of mathematics in the society as well as provide for further scholarship in the discipline" (p. 60). Haver and Turbeville (1995) believe that a precalculus course outline needs to include topics in probability and statistics for the purpose of data analysis (p. 46).

## Summary

The literature revealed that the purpose of a course outline is to communicate to students specific information about the particulars of a specific course. The objectives of a course outline are twofold. First, to prepare students for subsequent academic courses in a particular field. Second, to motivate students to want become subject matter experts. The course outline should contain a logical sequence of topics identified by main headings. Basic concepts should be presented first followed by more abstract concepts. Therefore, in closing the gap that exists between mathematical theory and application, the outline needs to present topics in a way that allows the students to conceptualize, explore, analyze, and solve abstract problems.

A mathematics course outline should include a review of prerequisite material in order to close the gap that may exist between preceding and succeeding courses. In addition, it is important to include topics on applications to problems in business and social sciences. However, there should be fewer topics to be covered to thus increase the mastery of prerequisite material. The literature also revealed that no more than ten percent of the topics should include the use of technology to enhance mathematical theory. The design process needs to synergetically incorporate students, objectives, methods, and evaluation.

An effective course outline in precalculus for BMSS needs to emphasize the importance of algebraic skills. The literature revealed that the foundation for further study in mathematics is strong algebraic skills. The objectives of a precalculus course outline are to provide a foundation for calculus, develop student's ability to solve complex problems, and enhance analytic skills by solving problems.

The literature also revealed nine major content areas for a precalculus course outline that include review of algebra, equations and inequalities in one-variable, graphs and functions, working with functions, polynomial equations, exponential and logarithmic functions, conics, systems of equations and inequalities, and other specific topics from algebra (e.g., sigma notation, induction, binomial theorem, sequences and series, permutations and combinations, and probability theory).

# Chapter 3

## METHODOLOGY AND PROCEDURES

### Procedures

The design used in this practicum report was the development methodology. Eight procedures were followed for the completion of this practicum report. First, a review of the literature was conducted. This review included design and development for a general course outline and mathematics course outlines in particular, design and development for precalculus course outlines, and sequence and content for precalculus course outlines.

Second, a panel of three experts (formative committee) was formed. Two of these experts are long time professors of precalculus for BMSS. The third member of this committee is a professor of mathematics with many years of teaching and curriculum experience. A complete listing of the participants and their credentials, as well as how and why they were chosen, is included in Appendix A.

Third, the formative committee was given information from the literature review pertaining to the design elements of course outlines, course sequence, course prerequisites to courses in general, mathematics courses, and precalculus mathematics courses in particular. The committee was asked to use this information to establish the criteria for the revised course outline. The committee provided guidance in the formative stages and reached consensus on the criteria after one revision. The established criteria was informally validated via telephone conversation by

the Assistant Dean of the Division of Mathematics and Sciences. A copy of the criteria established by the formative committee is in Appendix B.

Fourth, sample course outlines in precalculus or college algebra from Fullerton College, Saddleback College, Golden West College, Rancho Santiago College, and Irvine Valley College were secured. These most recent course outlines were reviewed to determine which topics are common among the colleges. The course outlines were also reviewed in order to determine how the courses differ among the colleges.

Fifth, a draft of the revised course outline was written by the author of this practicum report using the information gained from the literature review, the review of the precalculus course outlines from the other colleges, and the criteria established by the formative committee. The draft followed OCC's course outline format.

Sixth, the draft was reviewed by the summative committee for validation purposes using the criteria previously established by the formative committee. The summative committee included two senior professors of calculus for BMSS instruction, and the dean of the Division of Mathematics and Sciences at OCC. A complete listing of the summative committee participants and their credentials as well as why and how they were chosen is included in Appendix C.

Seventh, after reviewing the input from the summative committee, two revisions were made to the draft. The revisions were returned to the summative committee who reviewed the

recommendations. The committee agreed with the recommendations and reached consensus and a final draft was prepared.

Eighth, the final revised course outline was submitted to the dean of the Division of Mathematics and Sciences at OCC who in turn made a recommendation to the OCC curriculum committee to adopt the revised outline. A copy of the revised course outline is included in Appendix D.

## Assumptions

For this practicum, it was assumed that the formative committee had knowledge to guide the development of this project. It was also assumed that the five sample course outlines secured were valid. These course outlines were also assumed to be the most current for the development of this project. Furthermore, the expertise of the Summative Committee members was limited to their abilities to judge the final product based on the established criteria.

## Limitations

The product developed in this practicum report is limited in that it is specific to the needs of students enrolled in precalculus for BMSS at Orange Coast College. The product developed in this practicum report is further limited in that it is a specific pedagogical document to be used by professors of precalculus for BMSS at Orange Coast College.

# Chapter 4

# RESULTS

## Findings From the Literature Review

The literature review provided expert information on the design and development of courses in general and mathematics courses in particular. The literature review allowed for conceptualizing and justifying the results of the research questions, "What are the appropriate topics for a course outline in precalculus for BMSS students at OCC?", and "What should be the specific sequence of topics in the course outline?"

The investigation of the literature suggested that the course outline is the document that provides information about a particular course to professors and students. The results of the literature investigation also suggested fewer topics in the course outline to thus increase the probability of mastering the necessary prerequisite for success in calculus for BMSS. The literature indicated that review of prerequisite material, emphasis on algebraic skills, and mathematical applications (i.e., word problems) to business and social sciences are among some of the important topics that should be included in the revised course outline. The literature further suggested a constructivist approach in that the general sequence of topics should range from simple concepts followed by more abstract concepts and ideas.

Findings From Course Outlines of Colleges in Orange County

Copies of the most current course outlines in precalculus and/or college algebra from Fullerton College, Golden West College, Irvine Valley College, Rancho Santiago College, and Saddleback College were obtained via telephone request. These curriculum documents suggested that a course outline in precalculus should have between eight and ten topics from advanced algebra with an emphasis on applications. An examination of these course outlines revealed that the appropriate course title for a prerequisite calculus for BMSS course should be college algebra. These documents also indicated that a course in college algebra should be taught in a 4-hour per week format. Further examination of the course outlines provided little evidence to recommend the use of graphics calculators.

Analysis of the Precalculus Course Outline From Fullerton College

A qualitative analysis of the precalculus course outline from FC revealed that this course entitled Elementary Functions: College Algebra and Analytic Geometry is a 4-hour per week course designed to prepare students for the study of calculus. The topical content of this precalculus course included a review of algebra, relations, functions, solutions of first and second degree equations and inequalities, systems of equations, determinants, binomial theorem, mathematical induction, polynomial functions and theory of equations, analytic geometry and conic sections, and geometrical and arithmetical sequences and series. This course outline divided the sequence of topics

into two main sections: Review and new material. The review section included basic concepts of real numbers, polynomials, fractions, exponents and radicals, equations and inequalities, and linear as well as quadratic functions. The second section for this course outline included topics in analytic geometry, systems of equations, partial fractions, binomial theorem, mathematical induction, theory of equations, sequences, and series. The second section of this course outline revealed that 67% of the course is designated as "new material".

Analysis of the Precalculus Course Outline From Golden West College

A qualitative analysis of the outline for the course described as college algebra from GWC revealed that the course is designed as a 4-hour per week class which is delivered to students in the form of weekly lectures and/or discussions. Further analysis revealed that this course is designed for students needing to improve the algebraic skills necessary for success in calculus for BMSS and finite mathematics. The course outline also recommended the use of a graphics calculator such as the TI-81 or TI-85. A review of this course outline demonstrated evidence that the course content is comprised of the following ten topics:

1. Basic concepts of algebra review
2. Equations, inequalities, and problem solving
3. Coordinate geometry and graphing techniques
4. Functions
5. Linear and quadratic functions

6. Exponential and logarithmic functions

7. Theory of equations (polynomial and rational functions)

8. Systems of equations and algebra of matrices

9. Sequences and series

10. Counting principles and probability theory

Finally, this course outline indicated that items 7, 8, 9, and 10 from the above list of topics are not normally covered in intermediate algebra.

Analysis of the Precalculus Course Outline From Irvine Valley College

This curriculum document indicated that the outline for the course entitled college algebra at IVC was designed to meet five hours per week to thus prepare students to enroll in a calculus course for non-science majors. According to this course outline, the sequence and content of the topics covered were divided into six categories which included fundamentals of algebra, equations and inequalities, functions and graphs, polynomial and rational functions, exponential and logarithmic functions, and systems of equations and inequalities. Each of these areas was further divided into several specific topics.

In conducting a qualitative assessment of this course outline, there was no evidence that topics in counting principles and probability theory were covered. The course outline for college algebra at IVC revealed that the emphasis of this course was on equations and inequalities, relations and functions, polynomial and rational functions, exponential and logarithmic functions, matrices and determinants, sequences and series,

limits, binomial expansion, and curve sketching techniques. The IVC course outline did not make any recommendations on the use of technological devices such as graphics calculators.

Analysis of the Precalculus Course Outline From Rancho Santiago College

A qualitative analysis of this course outline entitled college algebra revealed that the purpose of the course was to present topics in advanced algebra to thus develop the mathematical maturity of students to succeed in calculus and other subsequent courses requiring college algebra. The major content areas for this course as described in the outline included:

1. Basic algebra, exponents, radicals, and rational expressions
2. Linear, quadratic, polynomials, absolute value, rational equations, and inequalities
3. Graphs and functions
4. Exponential/logarithmic functions
5. Solutions to systems of linear/non-linear equations
6. Algebra of polynomials
7. Counting and probability

A review of this course outline also revealed that the course was designed to be presented as a 4-hour per week class in a lecture/discussion format. The review also indicated two optional content areas. These areas included the binomial theorem and mathematical induction. Furthermore the analysis of

the RSC precalculus course outline presented strong evidence to indicate the importance of probability theory as a component of the entire course content.

Analysis of the Precalculus Course Outline From Saddleback College

The qualitative analysis of this 4-hour per week lecture only course outline entitled college algebra provided a description of the course in terms of its contents. This description indicated that college algebra at SC consists of a review of basic algebra topics such as functions, polynomials, logarithms, systems of equations, and matrices. There was no documented evidence about coverage of topics in counting principles, or probability theory, or both in this course outline. Thus, suggesting exclusion of these topics.

The course sequence and content was divided into six categories which included fundamentals of algebra, equations and inequalities, functions and graphs, polynomials and rational functions, exponential and logarithmic functions, and systems of equations and inequalities. These six categories were further subdivided into specific topics from advanced algebra.

Summary of the Commonalities Among Outlines

The results obtained from a comprehensive qualitative analysis from the precalculus course outlines from the five colleges indicated that four out of five colleges agreed that the title for a course designed to prepare students for the study of calculus for BMSS should be identified as "college algebra". The word "precalculus" was not used as a descriptor in any of the

course outlines. Furthermore, four out of five course outlines from the neighboring colleges in Orange County indicated that the course should be offered as a 4-hour per week class.

The major broad topical areas identified by all five colleges were:

1. Review of Algebra
2. Equations and Inequalities
3. Polynomials
4. Rational Expressions
5. Radical Expressions
6. Functions
7. Logarithms
8. Systems of equations

Summary of the Differences Among Outlines

The results obtained from the qualitative analysis of the five course outlines from the sampled colleges in Orange County revealed that FC was the only institution that used the title of "Elementary Functions: College Algebra and Analytic Geometry" instead of "College Algebra". In addition, the course outline from IVC was the only curriculum document suggesting a 5-hour per week class format instead of a four-hour per week format.

Further qualitative analysis of the five course outlines revealed that FC, GWC, RSC, and SC agreed that the course outline should include topics in analytic geometry and theory of equations. The course outlines from FC, GWC, and RSC differed from the other course outlines in that these curriculum documents included the topic of sequences and series. The documents from

GWC and RSC included probability theory as a component of the course outline. Mathematical induction and the binomial theorem were main topics for the FC and RSC course outlines only. Further analysis of the five course outlines revealed that FC was the only institution that presented the topic of partial fraction as one of the many components of the course outline.

## Development of the Criteria for a Revised Precalculus Course Outline

The criteria for a revised course outline in precalculus for BMSS at OCC were extracted from the literature review and current precalculus course outlines from five nearby community colleges in Orange County. The developed criteria was as follows:

1. Emphasis on computational skills and algebraic techniques to solve applied problems.
2. Review of mathematics prerequisites as topics come up.
3. Clear statement of course objectives.
4. Clear statement of teaching methods.
5. Inclusion of the following areas:
    a. Review as topics come up
    b. Graphs of functions
    c. System of linear and quadratic equations
    d. Sequences and series
    e. Logarithms and exponential functions
    f. Permutations and combinations
    g. Probability theory
    h. Binomial theorem
    i. Matrix theory

j. Applications of matrices (e.g., linear programming)

k. Mathematical induction

6. Selection of one text

The formative committee was called to a meeting and reached consensus after one revision of the criteria for the development of the revised course outline in precalculus for BMSS. The changes made by the formative committee during this meeting suggested that the course outline needed to include fewer topics with emphasis on problem solving, and a greater percentage of applications as opposed to computational skills only. Hence, the first item of the developed criteria was changed from "emphasis on computational skills and algebraic techniques to solve applied problems" to "the revised course outline must emphasize problem solving and include a greater percentage of applied problems as opposed to computational problems only." In addition, the topics on permutations and combinations, applications of matrices, and mathematical induction were removed from the original criteria so that fewer topics would be covered with greater emphasis on problem solving. The topic on matrix theory remained in the criteria as an optional item only. The committee also suggested sensitivity to the learning styles of students, and encouraged professors to use graphics calculators as an aid to analysis and problem solving. The formative committee agreed that it would be best to recommend at least two textbooks to choose from instead of only one textbook as suggested prior to the first revision of the criteria. The rationale was based on the fact that a choice between two or more textbooks would allow greater flexibility for

professors who teach precalculus for BMSS. The recommendations concerning textbooks were to select publications with titles such as College Algebra, Applied College Algebra or College Algebra With Applications. According to the committee, textbooks need to be congruous with the developed criteria and published within the last five years. Another change in the criteria suggested by the formative committee indicated that "review as topics come up" needed to be replaced with "review of intermediate algebra as topics come up." All the recommendations made by the formative committee were appropriate and therefore incorporated in the final criteria for the development of a revised course outline. This criteria was validated by the Assistant Dean of the Mathematics and Sciences Division at Orange Coast College. A copy of the criteria is included in Appendix B.

## Development of a Draft for a Revised Precalculus Course Outline

The draft for the revised course outline was created based on the formative criteria. This draft included the following sequence and content of general topics for the revised course outline:

1. Equations, inequalities, polynomials, and rational expressions
2. Graphs of polynomials and rational functions
3. Systems of linear and quadratic equations
4. Binomial theorem
5. Logarithmic and exponential functions
6. Sequences and series

7. Discrete probability theory

8. Matrix theory (optional)

A copy of the draft was submitted to the summative committee who were later called to a meeting to discuss the draft. At the meeting the committee made recommendations to change the course title from "Precalculus for BMSS" to "College Algebra." The members of the summative committee indicated that the title "College Algebra" would be consistent with similar courses offered at nearby community colleges in Orange County. The committee also indicated that in changing the course title it would be necessary to change the OCC course number from "Math 130" to "Math 152" because this would suggest a natural sequence for the succeeding course: Calculus for BMSS students which is Math 157 at OCC.

The committee also suggested a change in the number of credit hours from three to four units. The rationale for this recommendation was that many community colleges in Orange County offered similar college algebra courses as 4-unit courses. One of the members of this committee who is also an adjunct professor of mathematics at two other community colleges in Los Angeles County indicated that many colleges in Los Angeles County offered college algebra courses rather than precalculus for BMSS courses. He further indicated that the majority of these college algebra courses were offered as 4-unit courses as opposed to 3-unit courses. This committee member also indicated that the mathematical community uses the term "precalculus" in

reference to the course that precedes the required calculus course for students majoring in engineering, physical sciences, and mathematics.

The committee also agreed that some instructors may require the use of graphics calculators, and that students may need to know in advance whether or not a graphics calculator needed to be purchased for the course. In order to clarify this requirement the committee suggested that the revised course outline needed to identify the course name and number as "Math 152G" in the published schedule of classes to designate the requirement of a graphics calculator. Therefore, under the section entitled "Instructional Methodologies" of the final product, the following statement was recommended by the committee: "Some instructors may utilize or require the use of graphics calculators." Furthermore, the sentence "this course may be offered with emphasis on the graphics calculator as Math 152G" was added as the last sentence under the section entitled "Schedule Description" in the revised course outline.

A second draft was developed and distributed to the members of the summative committee who were later called again for a second meeting. The recommendations made during the second meeting were that the course outline needed to be streamlined. Therefore, writing the equation of a circle, evaluating a difference quotient, optimizing functions, graphing and analyzing the greatest integer function, and various subsections on analytic geometry needed to be deleted from the revised course outline. The committee also found that the sentence "it is

recommended that the instructor follow the broad content and sequence of topics 1 through 8 as shown below with Topic 8 as optional" needed to be included under the section entitled "Course Content and Scope/Topic Outline" on the second page of the second draft (i.e., the final product) for the purpose of clarification.

## Validation of the Revised Course Outline

The summative committee reached consensus after two revisions of the draft of the revised course outline. The revised course outline was prepared and submitted to the dean of the Division of Mathematics and Sciences with a recommendation to adopt the document. A copy of the final product is included in Appendix D.

# Chapter 5

# DISCUSSION, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

## Discussion

This study was conducted to develop a revised course outline in precalculus for biological, management, and social sciences at OCC to better prepare students for success in the required calculus course for BMSS majors. The concern that led to the development of a revised course outline in this development study was that although students completed the precalculus course, only 52% of the students successfully completed the required 1-semester calculus course (S. Johnson, personal communication, February 27, 1995).

The literature clearly shows that success in calculus is based upon adequate preparation in precalculus mathematics. This preparation requires a logical sequence of topics and content material in precalculus mathematics that emphasizes algebraic skills, problem solving skills, and an increased percentage of applied problems. The literature supported the use of technological devices such as graphics calculators as an aid to analysis and development of problem solving skills.

It is expected that the revised course outline in precalculus for BMSS will better prepare students to successfully complete the required 1-semester calculus course.

## Conclusions

A course outline in precalculus for BMSS needs to be streamlined in order to allow time to develop the necessary algebraic and problem solving skills for success in calculus.

The appropriate topics for a course outline in precalculus for BMSS students at OCC must be comprised of review of intermediate, systems of equations, binomial theorem, logarithmic and exponential functions, and probability theory. The specific sequence of topics in a precalculus course outline must begin with a review of algebra and followed by more abstract concepts in order to build the necessary algebraic and problem solving skills to solve applied problems.

The course outline must provide professors the option to select from at least two textbooks for teaching precalculus for BMSS students in order to accommodate the various teaching styles. The use of graphics calculators should be optional because not all professors may teach a precalculus course with an emphasis on the graphics calculator as an aid to problem solving. Some professors may teach a precalculus course from a traditional point of view, that is, using paper and pencil, and with an emphasis on mathematical proofs. Hence, the topic on proofs by mathematical induction should also be optional.

## Implications

The Department of Mathematics at OCC now has a tool that will provide an opportunity to better prepare students to successfully complete the required 1-semester calculus course. Furthermore, the mathematics department will also have an opportunity to better serve students by providing them with adequate preparation to fulfill the calculus requirement of their baccalaureate degree programs in BMSS, and subsequent courses in

BMSS that require the knowledge of calculus. Involvement of key faculty and administrators in the development of this tool should aid in its implementation.

## Recommendations

The Department of Mathematics at OCC should make an effort to implement the revised course outline. A meeting should be called for the purpose of dissemination of recent findings concerning precalculus curriculum and preparation of students in precalculus for BMSS.

## Recommendations for Implementation

Recommendations for implementation include, but are not limited to the following:

1. That the course number be changed from Math 130 to Math 152, and Math 152G for a course with emphasis on the graphics calculator.

2. That the name of the course be changed from "Precalculus for BMSS" to "College Algebra".

3. That the course be offered as a 4-unit per week course.

4. That the revised course outline for precalculus for BMSS (i.e., college algebra) be distributed to all Orange Coast College faculty who teach Math 130 (i.e., Math 152 and 152G), and calculus for BMSS for the purpose of familiarization with the new curriculum document.

5. That recommendation be made to the appropriate committee at Orange Coast College to reflect the changes made concerning the name and number of the course in the college catalog and schedule of classes.

6. That transfer institutions such as the University of California, California State University, and other private institutions be informed that a new course has replaced the precalculus course for BMSS.

Recommendations for Evaluation

Recommendations for evaluation of the product include, but are not limited to the following:

1. That the Department of Mathematics track the success rate in calculus for BMSS for students who have taken precalculus for BMSS based on the revised course outline.

2. That data be collected on the attrition rate of students taking the new course.

3. That the Department of Mathematics evaluate the appropriateness of the chosen textbooks.

4. That the revised course outline for precalculus for BMSS be evaluated shortly after its implementation.

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# APPENDIXES

## Appendix A

Names and Backgrounds of the Members of the Formative Committee

Valerie Hayward, M.A.

Valerie Hayward is an assistant professor of mathematics with many years of teaching experience at Orange Coast College and at California State University, Long Beach in developmental and advanced mathematics. She has taught precalculus for BMSS students at Orange Coast College for the past several semesters. Professor Hayward was selected for the purpose of this practicum because of her expertise in the design and development of the Harvard Calculus Curriculum at Orange Coast College. Professor Hayward has expressed concerns about the precalculus course at many department meetings, and was asked by the author of this practicum to participate in the formative assessment of this development research effort. Her research and mathematical interests are in reformed calculus and the use of technology in mathematics education.

Mark Clark, M.S.

Mark Clark is a lecturer in mathematics at Orange Coast College, and has taught precalculus for BMSS majors at Orange Coast College and other community colleges for many semesters. Professor Hayward recommended him to participate in the formative assessment of the project because of his teaching experience in precalculus for BMSS students at other community colleges. Mark Clark has a keen interest in this project because he believes that the use of technology should be incorporated in the mathematics curriculum at Orange Coast College. His research and

mathematical interests are in topology, the use of the graphics calculator in the mathematics curriculum, and the improvement of precalculus mathematics in its role to prepare students for calculus. In addition, Professor Clark in currently involved as a participant in a curriculum research project concerning the pedagogy of intermediate and college algebra in the community college system with the University of Chicago.

Wayne Wolfe, M.A., M.Ed.

Wayne Wolfe is a professor of mathematics with over twenty years of teaching and administrative experience in developmental mathematics at Orange Coast College. Professor Wolfe was asked to participate on the formative committee for this practicum report because he has served as the Chair of the Curriculum Committee at Orange Coast College for many years. His experience in designing, developing, evaluating, and approving courses, course outlines, and revised courses is valuable to the success of the revised course outline for precalculus for BMSS majors at Orange Coast College. Professor Wolfe held the position of Dean of Admissions and Records for many years where he acquired valuable experience in course articulation with the California State University and University of California systems.

Appendix B

Formative Committee Criteria

The criteria developed by the formative committee is as follows:

1. The revised course outline must emphasize problem solving and include a greater percentage of applied problems as opposed to computational problems only.

2. The review material (e.g., elementary and intermediate algebra) should be incorporated into the entire course outline as topics come up or as needed.

3. There needs to be fewer topics in the revised course outline to create the time necessary to teach analysis of problems.

4. The revised course outline needs to be sensitive to the various learning styles of students.

5. The revised course outline needs to incorporate the use of technology as an aid to analysis and problem solving.

6. The revised course outline needs to have a clear statement of course objectives.

7. The revised course outline needs to have a clear statement of teaching methods.

8. The revised course outline must include the following broad areas:

    a. Review of intermediate algebra as topics come up. (e.g., equations, inequalities, polynomials, and rational expressions.)

b. Graphs of functions

(1) Polynomials

(2) Rational

c. Systems of equations

(1) Linear

(2) Quadratic

d. Binomial theorem

e. Logarithmic and exponential functions

f. Sequences and series

g. Probability theory

h. Matrix theory (optional)

9. At least two recommended textbooks published within the last five years and with titles such as either College Algebra, Applied College Algebra or College Algebra with Applications that would best resemble the final product.

## Appendix C

Names and Backgrounds of the Members of the Summative Committee

Stan Johnson, M.A.

Professor Johnson is the Dean of the Mathematics and Sciences Division at Orange Coast College and has taught chemistry for over twenty years. He was also the department chair for the Department of Chemistry prior to becoming the Dean of the Mathematics and Sciences Division. Professor Johnson was asked to serve in the summative committee because one of the responsibilities of his position is to review and recommend for approval all new and revised courses and course outlines to the Curriculum Committee. In his role as a dean, he is required to attend the curriculum committee meetings. He also has many years of experience in designing and developing courses and course outlines in chemistry. He is also a member of the committee responsible for the articulation of courses between Orange Coast College and the California State University and University of California systems.

Bob C. Denton, M.S., M.A.

Professor Denton is the chair of full time faculty in the Department of Mathematics at Orange Coast College and has taught mathematics for over twenty five years. Prior to his tenure at Orange Coast College, he was an applied mathematician in the private sector. Professor Denton was selected for participation on the summative committee because of his twenty year experience in designing and developing mathematics courses and in teaching both precalculus and calculus for BMSS majors. Bob Denton is

also the chair of the calculus for BMSS course/curriculum committee. His mathematical interests are in probability, statistics, finite mathematics, calculus curriculum, and precalculus curriculum. He is a member of many mathematical organizations, and has been a guest speaker at many mathematics conferences. Professor Denton has written many papers in various mathematical journals and has recently published a book in finite mathematics.

Arthur Moore, M.A.

Arthur Moore is currently an associate professor of mathematics at Orange Coast College and has taught mathematics at California State University and at Golden West College. In his twenty years of experience, he has taught developmental mathematics as well as advanced and graduate mathematics courses. Professor Moore was selected to be a member of the summative committee because of his experience in teaching the entire mathematics curriculum at Orange Coast College. He is also the chairperson of the Honors Calculus Program at Orange Coast College and has designed and developed the honors calculus curriculum. Professor Moore teaches calculus for BMSS students on a regular basis and has been a member of the curriculum and articulation committees. Professor Moore has written many articles in several mathematical journals and has published a book on abstract algebra. His interests are in mathematical physics, analysis, honors calculus, and topology.

Appendix D

Revised Course Outline in Precalculus for Biological, Management, and Social Sciences at Orange Coast College

**ORANGE COAST COLLEGE COURSE OUTLINE OF RECORD**

Course developer: Dan Scanlon Course static ID: 1852

TOP No. 1701.0000 CIP No. 27.0101 Course adoption: 4-19-89

Date revised: 5-3-96 Revised by: E. J. Arismendi-Pardi

**COURSE MASTER DICTIONARY DATA**

Title 5 credit status: Associate degree credit course x Nondegree credit course ____ Noncredit course ____

Course name/number: Math 152 or Math 152G Division: Math & Sciences

Course title: College Algebra Department: Mathematics

Units: 4.0 Total course hours: 72 Course length: 18 weeks

Weekly hours configuration: 4.0 LHE: 4.000

Grading method: Graded _____ CR/NC _____ Student option x Noncredit _____

Method of Instruction: 10 (2 digit no.) Basic skills status: N (P, B or N)

Materials fee: No x Yes _____ $ _____

Justification:

**COURSE PREREQUISITE/COREQUISITE/ADVISORY:**

Math 030 - Intermediate Algebra

**CATALOG DESCRIPTION:**

This college algebra course is designed to prepare students whose majors are in the liberal arts, or to prepare students majoring in the biological, management, and social sciences for the one-semester course in calculus for BMSS (Math 157) or as a terminal transfer course. This is a transferable course which meets the mathematics requirement of transferring students. The topics included in this course are review of intermediate algebra as such topics occur, graphs of rational functions, system of linear and quadratic equations, binomial theorem, sequences and series, logarithmic and exponential functions, and introduction to discrete probability theory. The emphasis of this course is on applications and problem solving techniques.

**SCHEDULE DESCRIPTION:**

Advanced algebraic techniques with greater emphasis on applied problems in business, management, and the social sciences. This course may be offered with emphasis on the graphics calculator as Math 152G.

**COURSE CLASSIFICATION:**

| | | | | | |
|---|---|---|---|---|---|
| A | Liberal arts/AA | x | D-H | Community course | |
| B | Remedial | | I | Occupational required | |
| C | Remedial | | I | Occupational elective | |

**COURSE TRANSFER:** (Faculty developer's intent)

| | | | | | |
|---|---|---|---|---|---|
| 0 | Non-transfer/Non-AA | | 2 | Transfer CSU | |
| 1 | Non-transfer AA | | 3 | Transfer UC, Private | x |

**JUSTIFICATION FOR THE COURSE:**

Comparable to UC and CSU courses designed to meet mathematics requirement.

**COURSE CONTENT AND SCOPE/TOPIC OUTLINE:**

It is recommended that the instructor follow the broad content and sequence of topics 1 through 8 as shown below with Topic 8 as optional.

THIS IS THE BASIC COURSE OUTLINE FOR THE CONTENT AND SEQUENCE OF GENERAL TOPICS:

1. EQUATIONS, INEQUALITIES, POLYNOMIALS, AND RATIONAL EXPRESSIONS.
2. GRAPHS OF POLYNOMIAL AND RATIONAL FUNCTIONS.
3. SYSTEMS OF LINEAR AND QUADRATIC EQUATIONS.
4. BINOMIAL THEOREM.
5. LOGARITHMIC AND EXPONENTIAL FUNCTIONS.
6. SEQUENCES AND SERIES.
7. DISCRETE PROBABILITY THEORY.
8. MATRIX THEORY (OPTIONAL).

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**DETAILED COURSE OUTLINE FOR THE CONTENT AND SEQUENCE OF TOPICS**

Weeks 1 - 3 TOPIC 1: EQUATIONS, INEQUALITIES, POLYNOMIALS & RATIONAL EXPRESSIONS.

Review of real numbers and rules of algebra.
Write linear equations.
Construct linear models.
Solving/graphing quadratic functions.
Derive the quadratic formula.
Analyze quadratic functions with the graphics calculator.
Quadratic equation applications in business, economics, geometry, inventory control, and health sciences.
Solving/graphing polynomial, radical, and absolute value functions.
Applications of polynomial, radical, and absolute value functions in business and economics.
Solving/graphing linear inequalities.
Applications of linear inequalities to business, economics, finance, and break-even analysis.
Solve polynomial and rational inequalities.
Applications of polynomial and rational inequalities in finance, geometry, deficit, and population growth.

Weeks 4 - 5 TOPIC 2: GRAPHS OF POLYNOMIAL AND RATIONAL FUNCTIONS.

Review of radicals, simplification of radicals, rational exponents, and use of calculator to evaluate radicals.
Analysis of linear equations: Point-slope form, parallel and perpendicular lines.
Graphs of polynomial and rational functions.
Use the graphics calculator to graph and analyze functions.
Applications of quadratic, cubic, and polynomial models in business, management, and social science.
Construct linear models given a set of observations or data.
Applications of linear models in taxation, finance, business, and economics.
Use and apply linear models to solve statistical problems.
Exploration and introductory analysis of quadratics/polynomial models.

Weeks 6 - 8 TOPIC 2: GRAPHS OF POLYNOMIAL & RATIONAL FUNCTIONS.

Familiarization with definition of a function, function notation, domain and range of functions.
Applications of functions to optimization problems in business and economics as a preparation for calculus.
Exploration of functions with the graphics calculator.
Analysis of functions: increasing, decreasing, and constant function, even versus odd functions.
Applied problems using the concept of a function to solve banking, cost/revenue, and population growth.
Various functions and its characteristics: constant, identity, absolute value, square root, quadratic &cubic.
Translation and combination of functions: Shifting, reflecting, and stretching graphs.
Algebra of functions.
Applications of functions in business, economics, and life sciences.
Finding the inverse of a function: graphically and algebraically.
Quadratic functions: write the standard form of a quadratic function.
Find the equation of a parabola.
Translation, vertical and horizontal shifts of quadratic functions: algebraically/graphics calculator.
Applications in business and economics.
Understanding the Intermediate Value Theorem.
Graphing polynomial functions by using by using the Intermediate Value Theorem.
Introduction to limits.
Find vertical/horizontal asymptotes, and use the concept of limits to graph rational functions.
Explorations of rational functions with the graphics calculator.
Applications in sales, business, and economics.

Weeks 9 - 10 TOPIC 3: SYSTEMS OF LINEAR AND QUADRATIC EQUATIONS.

Solve a system of three or more linear equations.
Solve a system of quadratic/nonlinear equations.
Applications of linear systems in business, economics, and statistics.
Graph and solve system of inequalities.
Introduction to linear programming: use the graphical/algorithmic methods to solve a simple LP problem.
Solve an applied LP word problem: write the objective function as well as linear constraints.
Sigma notation properties and curve fitting.

Weeks 11 - 12 TOPIC 4: BINOMIAL THEOREM.

Calculate permutations and combinations.
Use the binomial theorem to expand binomials and to find a term in a binomial expansion.
Find the binomial coefficients using Pascal's triangle.
Simple counting problems using combinations and permutations.
Combinatorial analysis
Applications of the binomial theorem.


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Weeks 13 - 14 TOPIC 5: LOGARITHMS AND EXPONENTIAL FUNCTIONS.

Define and graph exponential functions of base 'e' and/or base 'b'.
Sketch the graphs of a variety of exponential functions with and without a graphics calculator.
Applications in finance and radioactive decay.
Graph logarithmic and natural logarithmic functions.
Various applications of logarithmic functions.
Apply the properties of logarithms to write logarithms as a single/multiple expressions.
Solve exponential and logarithmic equations.
Analyze and apply exponential and logarithmic models such as logistic growth model.
Applications in population growth, radioactive decay, learning curve, Newton's law of cooling.

Weeks 15- 16 TOPIC 6: SEQUENCES AND SERIES.

Find the terms of a sequence.
Evaluate finite sums.
Use the graphics calculator to find sums.
Use summation notation to find the sums of infinite sequences.
Give an example of a geometric and an arithmetic sequence.
Find the nth term of an arithmetic sequence.
Find the nth term of a geometric sequence.
Find the sum of a finite or infinite sequence.
Various applications of sequences and series.

Weeks 17 - 18 TOPIC 7: DISCRETE PROBABILITY THEORY.

Introduction to probability.
Find the probability of a simple event.
Use the sum and product rule to find various probabilities.
Calculate the probability of dependent and independent events.
Use the complement rule to calculate the probability of an event.
Introduction to statistics: calculate and interpret the mean and standard deviation.
Construct a histogram.

TOPIC 8 ON MATRIX THEORY IS OPTIONAL AND DEPENDENT ON AVAILABILITY OF TIME.

Properties of matrices.
Algebra of matrices.
Gauss-Jordan method.
Finding the inverse of a matrix.
Applications in economics and linear programming.

**INSTRUCTIONAL OBJECTIVES:**

Upon completion of the course the student should be able to:

1.) Solve equations and inequalities using algebraic definitions and axioms.
2.) Graph linear, quadratic, and cubic functions by using intercepts, symmetries, and point plotting.
3.) Add, subtract, multiply, and divide functions as well as to determine the domain and range of functions.
4.) Graph rational functions and find asymptotes as well as using the concepts of infinity to study its behavior.
5.) Use logarithmic properties to solve exponential and logarithmic equations.
6.) Write an expression as a single logarithm or as a combination of a logarithmic polynomial of first degree.
7.) Solve and apply systems of linear equations in two and three variables.

8.) Find the nth term of a sequence/series.
9.) Find the sum of a sequence/series.
10.) Use sigma notation to evaluate sums.
11.) Use the binomial theorem to expand binomials.
12.) Evaluate probabilities of simple events.
13.) Use technology to analyze and solve advanced algebraic problems.

**METHOD OF STUDENT EVALUATION:**

Grades are determined by performance on exams, quizzes, homework, and collaborative projects. A comprehensive final exam is part of the course evaluation.

**INSTRUCTIONAL METHODOLOGIES:**

The primary mode of instruction is the lecture/demonstration method as well as in-class exercises that allow students to analyze and solve problems. Some instructors may also utilize or require the use of graphing calculators.

Various types of collaborative activities are included in order to incorporate the various learning styles of students in the learning experience.

**WRITING ASSIGNMENTS/PROFICIENCY DEMONSTRATION:**

Computational, and applied problems (i.e., word problems) commonly appear on exams and/or quizzes. These require written responses. Critical thinking and problem solving skills are part of this course

Collaborative projects or case studies requiring rigorous analysis are assigned in order to encourage students to actively participate in the learning process.
Results of analysis of problems or projects are required to be presented in class.

**REPEATABILITY:**

Does not apply.

**FEASIBILITY:**

Several sections of this course are offered using existing faculty and classrooms.

**EDUCATIONAL MATERIALS:**

The required text is listed below, and only one text is used in each course. Student's solutions manual and study guides may be encouraged to be used by some individual instructors, but are not required for this course. Some instructors may also require the use of the graphics calculator. The book by Larson, et. al. should be used by instructors who desire to use the graphics calculator. Instructors desiring to teach a more classical approach with limited used of the graphics calculator should use the book by Barnett and Ziegler.

Barnett, R. A., & Ziegler, M. R. (1993). College Algebra (5th ed.). New York, NY: McGraw-Hill.

Larson, R. E., Hostetler, R. P., & Hodgkins, A. V. (1996). College Algebra: Concepts and Models (2nd ed.). Lexington, MA: DC Heath Publishers